

## **VII. Abstract**

5 The invention relates to improved multi-axis joysticks and associated multi-axis  
optical displacement measurement means. The displacement measuring means may include  
one or more light emitters and one or more light detectors, preferably mounted in a planar  
hexagonal array. The relative position of an adjacent movable reflector assembly can be  
measured in six degrees of freedom by variations in detected light amplitude. Various  
ergonomic configurations of six axis joystick embodiments which may be facilitated by the  
10 compact design of the transducer means are disclosed. Means for dynamically adjusting  
coordinate transformations for construction machinery control are also disclosed.